

In re: Yakobson  
Serial No.: 09/866,021  
Filed: May 23, 2001  
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#### REMARKS

##### Status of the Claims

Claims 24-25 and 28-32 are pending in the application. Claims 24-25 and 28-32 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Charlier et. al, *Structural and electronic properties of pentagon-heptagon pair defects in carbon nanotubes*, Phys. Rev. B., Vo. 53, No. 16, 11 108-113 (hereinafter "Charlier"). Claim 24 has been amended to expedite prosecution.

##### Claims 24-25 and 28-32 are patentable over Charlier

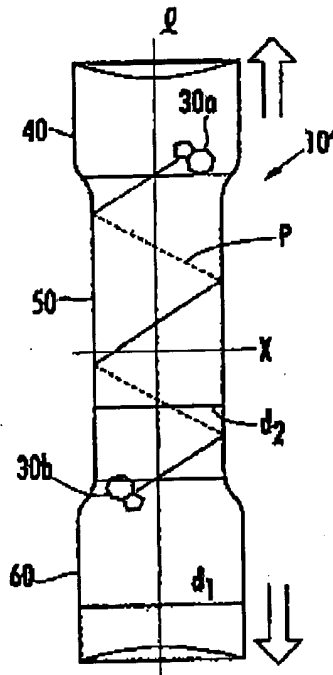
Independent Claim 24 as amended recites (emphasis added):

a dipole of pentagon-heptagon and heptagon-pentagon dislocation cores located in an opposed spaced-apart relationship along a spiral propagation path along a longitudinal axis of said carbon nanotube;

a first region comprising a domain of modified lattice structure positioned between said dipole and formed by said dipole propagating throughout the nanotube as a result of stress being applied to said nanotube;

The spiral relationship of the dipole of pentagon-heptagon and heptagon-pentagon dislocation cores is illustrated in Figure 3 of the present application, which is reproduced below.

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### Figure 3

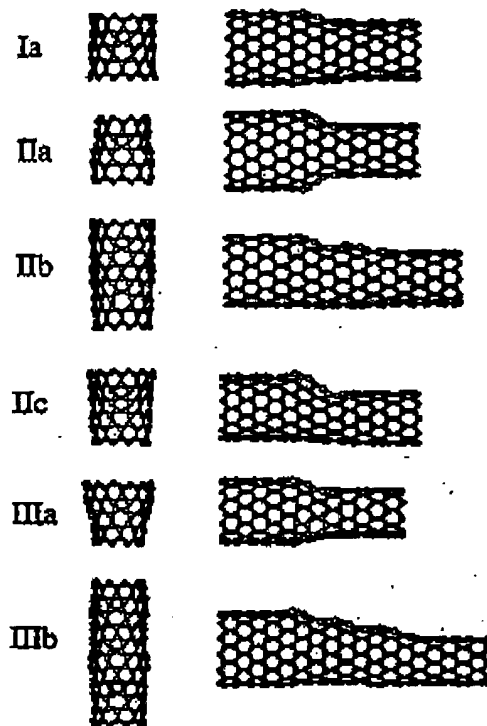
Applicant submits that Charlier, in contrast to the carbon nanotube recited in Claim 24 as amended, proposes single pentagon-heptagon pair "defects" that are not spatially related to one another, for example, by a spiral propagation path. Charlier discusses that "a pentagon-heptagon pair defect can also be incorporated in a straight nanotube, allowing the connection of two cylindrical straight portions with different diameters and, possibly, chiralities, leading to the design of metal-semiconductor, metal-metal, or semiconductor-semiconductor devices." Charlier, page 108, paragraph 3. However, Charlier is primarily concerned with 5/7 pair defects that are randomly aligned. Charlier, page 108, paragraph 2. Charlier seeks to eliminate 5/7 pair defects, and proposes that eliminating 5/7 pair defects improves consistency and quality. Charlier further proposes that 5/7 pair defects can annihilate when oriented in opposite directions. See Charlier, page 113, first paragraph. The connection of two cylindrical straight portions with different diameters is shown in Figure 1 of Charlier, which is reproduced below.

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**Charlier: Figure 1**

Accordingly, Charlier does not teach or suggest a dipole of pentagon-heptagon and heptagon-pentagon dislocation cores in an opposed spaced apart relationship along a spiral propagation path as recited in Claim 24, as amended.

The Action concludes with respect to Claim 29 that "it is expected that the domain of modified lattice structure propagates in an imaginary spiral line between said defects, because the modified lattice structure is inherent to the opposed and spaced apart pentagon-heptagon defects. Alternative, it would have been obvious to one of ordinary skill at the time of invention that the modified structure propagates between said defects, as the defects are the cause of the modified lattice structure."

Applicant respectfully submits that the conclusion that a domain of modified lattice structure inherently or obviously propagates in an imaginary spiral line between defects is impermissible hindsight that is unsupported by Charlier. Charlier proposes that a single

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pentagon-heptagon pair defect can allow "the connection of two cylindrical straight portions with different diameters and, possibly, chiralities..." Charlier, page 108, paragraph 3.

Charlier does not teach or suggest linking three (or more) cylindrical nanotube portions of various diameters together by a dipole of pentagon-heptagon pairs. Even if the single pentagon-heptagon pairs in Charlier could be linked together to form three or more nanotube portions joined by two pentagon-heptagon pairs, nothing in Charlier suggests any relationship between pentagon-heptagons that join nanotube portions. Moreover, Charlier discusses that pentagon-heptagon pair defects annihilate with another pentagon-heptagon pair when oriented in opposite directions. Charlier, page 113, paragraph 2.

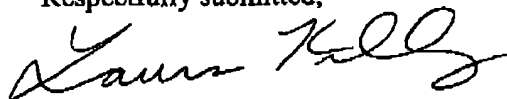
In contrast, Applicant's invention is directed to a carbon nanotube including a dipole of pentagon-heptagon and heptagon-pentagon dislocation cores located in an opposed spaced-apart relationship along a spiral propagation path. Such a construction is neither anticipated by nor obvious in view of the cited art. Accordingly, Claim 24 as amended is allowable over the cited art for at least the foregoing reasons. Claims 25 and 28-32 depend from Claim 24 and therefore are also allowable for at least these reasons as well.

Moreover, Claim 29 is independently patentable. Claim 29 recites that "the domain of modified lattice structure propagates in an imaginary spiral line between said pentagon-heptagon and heptagon-pentagon dislocation cores." For the reasons discussed above, Charlier does not teach or suggest propagation along a spiral line between the dislocation cores.

#### Conclusion

Applicant respectfully submits that, for the reasons discussed above, the present case is in form for allowance. Accordingly, Applicant requests allowance of all the pending claims and passage of this application to issue.

Respectfully submitted,



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CERTIFICATE OF MAILING

I hereby certify that this correspondence is being sent by facsimile transmission to the United States Patent and Trademark Office, Group Art Unit 1754 at (703) 872-9311 on May 7, 2003.

  
Carey Gregory

Date of Signature: May 7, 2003

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**VERSION WITH MARKINGS TO SHOW CHANGES MADE**

The following is an addendum to the concurrently filed Amendment in response to the Final Official Action dated March 7, 2003 in the above-referenced application. This addendum includes a marked-up version of the changes made to the specification and claims by the present Amendment.

**In the Claims:**

Please amend the claim as follows:

24. (Amended) A carbon nanotube comprising:

a dipole of pentagon-heptagon and heptagon-pentagon dislocation cores located in an opposed spaced-apart relationship along a spiral propagation path along a longitudinal axis of said carbon nanotube;

a first region comprising a domain of modified lattice structure positioned between said dipole and formed by said dipole propagating throughout the nanotube as a result of stress being applied to said nanotube; and

second and third regions each positioned on opposite sides relative to said first region, the second and third regions comprising lattice structure domains which differ from the domain of modified lattice structure in said first region such that said second and third regions possess a physical property different from the first region.

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